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nation can be recommended for any particular variety.

While it is generally possible to secure a higher percentage germination in the gelatin-sugar solutions than in the simple sugar solution, growth of the pollen tube is often less rapid, especially when the larger amounts of gelatin are used. This is frequently an advantage if large numbers of samples are being tested, since long, interlacing tubes make counting difficult.

E. J. KRAUS

OREGON AGRICULTURAL EXPERIMENT STATION

SCIENTIFIC BOOKS

Economic Geography. By JOHN McFARLANE, lecturer in geography in the University of Manchester. The Macmillan Company. 8vo. Pp. 560. \$2.25.

The work is based on the principle of natural regions. It is recognized, however, that political conditions control economic development so largely that the boundaries of countries, whether natural or arbitrary, must figure in the reckoning. Also true geographic units may be closely linked into a group dominated by one or more geographic factors.

Preceding the geography of continents and countries are three chapters on physical conditions of economic activity, climate and vegetation. These chapters occupy but 26 pages and it may be questioned whether so brief and general a statement is useful as an introduction to the main treatment. The author recognizes that the economic geographer relies on the geologist, meteorologist, botanist, etc., for the data which he correlates, and it would, in the reviewer's judgment, be as well to leave the case thus; for, to take an example, a non-geologist could not derive much help from the author's two-page account of rocks and geological periods, or from one page on the principles of geomorphology, or the like brief discussions of winds, ocean currents and the distribution of plants. Should we not frankly concede that this branch of geography is an advanced phase to be based on previous training in physical and biological geography?

The proportioning of space in the regional treatment is fairly balanced considering that

the text is no doubt expected to be used mainly by British students. This fact would justify 38 pages for the United Kingdom and 34 for the United States. Indeed most American texts are more one-sided than this. On the same basis we can not criticize the assignment of more space to India and Ceylon than to Germany, or giving two thirds as much space to Canada as to the United States. Our author used the term *economic* as designating the phase of anthropogeography here treated. It is not easy to see that the subject-matter differs in general scope from the volume by Mr. Chisholm, who although deeply versed in economic conditions, calls his handbook commercial geography. So, it would seem, we are still using these terms interchangeably. It is to be hoped that we may be able in time to arrive at more specific terminology.

As for the body of the work, we find sound, clearly expressed and informing accounts of the physical conditions, products and trade of the various countries, the work of a thorough and conscientious geographer. The illustrations are confined to maps, eighteen in number, mainly devoted to rainfall and the delineation of natural regions. Possibly the author's plan was deliberate, not to emphasize transportation either by map or text, and thus to justify somewhat the term *economic*. The chapter on the United States has been prepared with evident care. The map of natural regions conveys some misapprehensions which indeed a generalized map could not avoid. Some misleading boundaries, however, are qualified by statements in the text. Still it is not quite appropriate, as seen by an American geographer, to include the lake plains of New York and the coastal plain of New Jersey in a "Middle Appalachian Region."

The volume takes a good place among the few comprehensive manuals in English dealing with this aspect of geography.

A. P. BRIGHAM

IO AND ITS ENVIRONMENT

THE manuscript of Dr. Chas. C. Adams's paper on "The Variations and Ecological Distribution of the Snails of the Genus *Io*" was

completed more than three years ago, but has only recently been published.¹ However, little has appeared in the interim which bears directly on the subject and the author has not found it necessary to alter his original discussion.

Io is a small genus of large aquatic snails confined to the Tennessee River system and mainly to that part which lies upstream from Chattanooga. On looking over a representative collection of these shells one is immediately impressed with the great variation in their spinosity; some are absolutely smooth, and there is every intergrade from these to shells on which the spines are nearly or quite as long as the radius of the whorl. In addition there is a considerable range in the variates which one is tempted to call "ordinary"—general size of adults, globosity or shell index, color, and so forth. Adams examined chiefly the variation in shell diameter, globosity and spinosity. This he did by making careful measurements of large collections from stations throughout the range of the genus. Data for variation curves are given not only in absolute frequencies, but in "frequencies reduced to thousands" and in plotted curves. No data are given for studying correlated variation, nor has the variability of the characters been analyzed by use of the statistical methods now familiar, by reputation at least, to all students of evolution. There is probably ample justification for this omission in the fact that it is very difficult to be sure that a series is homogeneous with respect to age. At any rate, a large amount of data is offered to any enterprising biometrician who may care to tackle it, and the author seems to have gotten along fairly well, as far as he has gone, without a thorough mathematical analysis of the variability.

An inspection of the curves shows that there is a progressive change from the headwaters of the various branches of the river system downstream as follows: "From a greater diameter of the shell to less; from a high degree of

globosity to one of a less degree; from a spineless to relatively long spines; from a narrow space between the spines to a wider space; and from a relatively low spine index to one of a high degree. The change from the smooth to the spinose shell is relatively abrupt, as shown by the modes, but there is a perfect series of individual intergradations." The fact that in the Holston River near Rogersville there are smooth shells where one would expect from the foregoing to find spiny ones will be referred to later.

The generally accepted belief among paleontologists concerning the phylogenetic development of spines is quoted from Beecher² as follows:

The first species [of a group of animals] are small and unornamented. They increase in size, complexity and diversity, until the culmination, when most of the spinose forms begin to appear. During the decline extravagant types are apt to develop, and if the end is not yet reached, the group is continued in the small and unspecialized species which did not partake of the general tendency to spinose growth.

The author considers the possible effects of direct environmental action, hybridization and other factors as explaining the distribution of the various shell types, but there are not sufficient data at hand to reach a satisfactory conclusion. Experimental work was started but dropped because of lack of facilities. However, the orthogenetic "law of ornamentation" just quoted, taken in connection with stream history and the mixing of strains, seems to explain many of the facts.

What might be called phylogenetically young streams are rapid. In such the phylogenetically young *Io* developed, small and smooth. As time went on the streams became older, less rapid or with rapids further apart at the place where *Io* started, but the streams continued ever young at their heads where they worked back into the land mass. *Io* became phylogenetically older at its place of origin and progressed in its orthogenetic course toward

¹ Memoirs of the National Academy of Sciences, Vol. XII., Part II., Second Memoir, 1915, pp. 1-184, 61 plates.

² "The Origin and Significance of Spines. A Study in Evolution," Yale Bicentennial Publications, 1901, pp. 1-105.

large and spiny shells. The original type of snails followed the "young" part of the stream backward and thus there tends to be a continuous series of forms as one follows the stream. One has but to start at the headwaters and go down stream in order to see unfolded the history of both stream and shell. By the time Chattanooga is reached the stream has gotten too old, physiographically, for the snails, too deep and possibly too contaminated.

The finding of smooth shells near Rogersville in the Holston River and of spiny shells above them really fits in with this idea if we look more closely into the history of this part of the river system, for here there has been stream piracy. A young stream containing smooth shells has probably worked over into the valley of an old stream, containing spiny shells above the point of intersection, and the result is the Holston River as we now know it.

To be sure, we should like to have an explanation of the causes underlying the law of ornamentation, and also of the reason why the successively spinier snails seem to have forced their smoother relatives to migrate with the growth of the stream or to have been prevented from working up to the headwaters themselves, but we can not expect an explanation of the ultimate and Dr. Adams is to be congratulated on the progress which this paper makes in the, as yet, largely unexplored field of animal ecology.

FRANK E. LUTZ

THE PLIOCENE FLORAS OF HOLLAND

THE study of the more immediate progenitors of the existing flora, the vast changes in distribution, and the extensive extinctions and migrations that resulted from the glaciation of the Pleistocene, as well as the evolution of recent herbaceous forms that followed in its wake, constitutes a field of endeavor that not only appeals to the imagination, but one that offers much to botany and much that is useful in reconstructing the geography, climate and history of the late Tertiary and the Quaternary. For thirty-odd years Clement Reid has been engaged in the study of the Pliocene and Pleistocene deposits of Britain and their con-

tained floras. Some years ago with the assistance of Eleanor M. Reid he described the upper Pliocene flora of Tegelen in Holland,¹ and recently these authors have published the results of an elaborate study of similar remains from a slightly older horizon collected from the brick-clays of Reuver, Swalmen and Brunssum along the Dutch-Prussian border.²

This study is not only a significant contribution to the botany of the Pliocene, but it furnishes data of great importance to historical geology. With the shallowing of the Diestian or perhaps the Scaldisian sea, the delta of the combined Rhine and Meuse extended a long distance to the northwest as it did at several subsequent times during its history, as is proven by the Rhine gravels in the Cromer beds of Norfolk, and by the mammalian fauna and peat of the Dogger Bank. Remains of the middle Pliocene high-level terraces, much faulted, occur to the south and east of the Limburg plain, where the brick clays are exposed in the scarp facing that plain. The materials were collected by W. Jongmans of Leiden and P. Tesch of the Geological Institute for the exploration of the Netherlands. The Reids expended all of their efforts on the remains of fruits and seeds which they laboriously picked out of the washings of an enormous amount of material.

In the less lignitic loams lying immediately below the horizon reported upon, impressions of leaves occur and these were studied some

¹ Reid, C., and E. M., "The Fossil Flora of Tegelen-sur-Meuse, near Venloo, in the Province of Limburg," *Verhandl. Kon. Akad. Wetensch.* (Tweede Sectie), Deel XIII., No. 6, 1907; "On *Dulichium vespiforme* sp. nov. from the Brick-earth of Tegelen," *Verslag. Kon. Akad. Wetensch. Amsterdam*, 1908, p. 898; "A Further Investigation of the Pliocene Flora of Tegelen," *Ibidem*, 1910, pp. 192-199.

² Reid, C., and E. M., "Preliminary Note on the Fossil Plants from Reuver, Brunssum and Swalmen," *Tijdsch. Kon. Ned. Aardrijks. Genootschap*, 2e ser., Deel XXVIII., afl. 4, 1911, pp. 645-647; "The Pliocene Floras of the Dutch-Prussian Border," *Mededeelingen Rijksopsporing van Delfstoffen*, No. 6, The Hague, 1915, 178 pp., 4 tf., 20 pls.